973,264

PATENT SPECIFICATION

DRAWINGS ATTACHED

973,264

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COMPLETE SPECIFICATION

Improvements in or relating to Thrust Linkage Supporting Table

We, AMERICAN MANUFACTURING COMPANY, INC., a corporation of the State of Washington, United States of America, of 2119 Pacific Avenue, Tacoma 2, Washington, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a table adjustable in height for the purpose of supporting at different heights loads of material to be handled in manufacturing processes such as for feeding to a machine or received from a machine.

The principal object of the present invention is to provide a table variable in height through a wide range from a very low position to quite a high position such as several feet in height. Such variation in height can be effected in small increments, yet a substantial adjustment in height can be accomplished quickly. Another feature is to provide mechanism which will lock automatically to hold the table at a particular elevation without the necessity of performing a special latching or holding operation.

To enable the table to be lowered to a low, collapsed elevation it is necessary to provide compact actuating mechanism, yet it is an object to utilize such mechanism which will support a substantial load. Moreover, such mechanism must be capable of supporting such a load with the table in any elevationally adjusted position.

The mechanism can be of simple and comparatively inexpensive construction, although being rugged and requiring a minimum of repair and upkeep.

According to the invention a table adjustable in height comprises a base, a table top, thrust linkage, first pivot means having its axis located substantially centrally between opposite edges of said table top and connecting said thrust linkage to said table top, said thrust linkage being engaged with a portion of said base directly beneath said first pivot means, said thrust linkage including an upper link, a lower link, one of said links being bent, and second pivot means interconnecting said upper link and said lower link, actuator means pivotally connected to said bent link at only one location which location is spaced lengthwise of said bent link from said second pivot means, said actuator means being operable to effect relative swinging of said links between a folded position supporting said table top in a lowered position and an unfolded position supporting said table top in a raised position substantially parallel to such lowered position and stabilizing means interengaged between said base and spaced portions of said table top located at opposite sides of said first pivot means and operable to maintain said first pivot means in superposed registry with the portion of said base engaged by said thrust linkage and to restrain tilting of said table top relative to said base.

Embodiments of the invention will now be described by reference to the accompanying diagrammatic drawings in which:

Figure 1 is a top perspective of a table adjustable in height, with parts broken away.

Figure 2 is a side elevation of the table in an upper position of adjustment, Figure 3 is a similar view with the table in an intermediate position of adjustment, and Figure 4 is a similar view with the table in its lowermost position, different parts being broken away in the several figures.

Figure 5 is a plan of the table having parts broken away.

Figure 6 is a side elevation of another modification of the table in an upper position of adjustment, with parts broken away, Figure 7 is a similar view with the table in an intermediate position of adjustment, and Figure 8 is a similar view with the table in its lowermost position.

Tables adjustable in height have been used

[f ']

for various industrial purposes but it has been difficult to provide simple and economical mechanism for varying the height of such tables which would enable the table to be lowered sufficiently and alternatively enable the table to be raised to a sufficient height for most uses. The structure of the present table satisfies these requirements by employing thrust linkage which will support the table and a load on it and which can be moved to alter the elevation of the table. Stabilizing linkage is provided to maintain the desired attitude of the table, preferably in a horizontal position parallel to the base, in all positions of adjustment. The stabilizing linkage also will control edgewise movement or prevent such movement as the table top is raised and lowered.

In Figures 1 to 5, inclusive, the table base is composed of a frame including opposite channels 1, the corresponding ends of which are connected by end bars 2 which may be secured together in any suitable fashion such as by welding. To the side channels is connected the dog-leg thrust linkage including a supporting link 3 and a bent supported link including a short leg 4 adjacent to the link 3 and a long leg 5. The lower end of the supporting link includes a pivoted bar 6 having its opposite ends journaled in the channel sides 1 of the base frame generally midway between their ends. The short leg 4 of the upper supported link fits between spaced elements forming the adjacent end of the link 3 and these link ends are pivotally connected together by the pivot rod 7. The end of the supported link leg 5 remote from the supporting link 3 is connected by pivot 8 to the table top 9 at a location generally midway between its opposite ends.

The links of the dog-leg thrust linkage preferably are in the form of leaf frames as shown in Figure 1 so that the linkage cannot twist readily. The thrust linkage itself therefore acts to resist rotation of the table top 9 relative to the base 1, 2 about a vertical axis, but such thrust linkage would not prevent the table top from rocking about the axis of pivot 8 or the linkage from rocking about the axis of the pivoted member 6. Also, such leaf type thrust linkage would not prevent the table top from moving endwise by conjoint swinging of the linkage relative to the base about the axis of pivot member 6 and relative to the table top about the axis of pivot member 8 even though the two leaves of the thrust linkage maintain a constant angular relationship relative to each other. Stabilizing linkage is provided to prevent such tilting and endwise shifting of the table top relative to the base.

The stabilizing linkage of the table shown in Figures 1 to 5, inclusive, is of the cross type including crossed links at opposite sides of the table which are pivoted to the base, to the table top and to each other. Links 10 have their lower ends pivotally connected by pivots 11 to the opposite base side members 1 and the upper ends of such links carry rollers 12 received in the channels 13 along opposite sides of the table top 9 which bear against the upper flanges of such channel members. Links 14 crossing links 10 have their upper ends pivotally connected by pivots 15 to the table top 9 and their lower ends are connected to opposite end portions of the cross bar 16 on the opposite ends of which are mounted rollers 17 received in the side channels 1. The central portions of the crossed links 10 and 14 are interconnected by pivots 18.

Because the triangles formed by the stabilizing links 10 and 14 and by the base and table top above and below the link connecting pivots 18, respectively, are similar and of isosceles type, the base angles of such triangles will always be equal and the table top 9 will be maintained in horizontal position parallel to the base in all vertically adjusted positions of the table top. Moreover, because the links 10 and 14 are positively connected to the table top and the base by the pivots 15 and 11, the table top cannot shift endwise relative to the base as the height of the table top is adjusted. On the other hand, because the links 10 and 14 are free to swing relatively about pivots 18, such stabilizing linkage will not resist elevational movement of the table top. Any tendency of the table top to tilt sidewise is resisted primarily by the resistance of the thrust linkage to twisting although the connection of the lower ends of links 14 by the spreader member 16 also opposes unequal relative swinging of the links 10 and 14 at opposite sides of the table.

In Figure 2 the leaf links 3 and 4, 5 of the thrust linkage are shown in extended or relatively unfolded condition with the table top 9 in or near its uppermost position of adjustment. As the links of the thrust linkage move toward contracted or folded position through the relationship of Figure 3 to that of Figure 4, the table top 9 is lowered progressively into its lowermost position shown in Figure 4. In this position the thrust linkage can be relieved of all load by the table top being supported by short legs 19. One at each corner of the table top, the lower ends of which rest on the base channel sides 1. In this position the longer leg 5 of the upper thrust link is disposed substantially parallel to the lower link 3. Such relationship is made possible by providing the short leg 4 of the linkage which bridges between the lower end of the longer leg 5 of the upper link and the upper end of the lower link 3.

The relative swinging of the upper and lower links of the dog-leg thrust linkage is effected by applying a force to swing the links relatively about their connecting pivot 7. Such force can be produced by an actuator 20 which

is variable in effective length and reacts between the links. Such actuator is shown as being of the fluid pressure piston-and-cylinder type which preferably includes self-contained pressure fluid supply mechanism such as a pump 21 driven by a motor 22. By utilizing a positive displacement pump such as a gear pump or a vane pump and liquid which is substantially incompressible, the actuator 20 can be employed both to effect relative swinging movement of the thrust links and to block such linkage against contracting or folding movement under the influence of the load on the table top 9.

In order to be effective for raising or holding at a desired height a loaded table top, it is necessary for the actuator 20 to have a reasonably good leverage on the thrust linkage particularly when the thrust linkage is near closed position. As shown in Figure 4, a substantial lever arm through which the force of the actuator 20 is applied is afforded by the short leg 4 of the upper link. The most effective leverage is obtained by pivoting the upper end of the actuator to the upper link approximately at the location of the bend in the upper link by a pivot 23. The length of the lever arm through which the force applied by the actuator 20 acts is always the perpendicular distance from pivot 7 to a line joining the pivots 6 and 23 at opposite ends of the actuator 20. The effective link-swinging moment of the actuator 20 therefore varies with the angle between the line of thrust of the actuator and a line joining the axes of the pivots 6 and 7 of link 3. The actuator thrust is most effective to swing link 5 when such angle is greatest because the lever arm is then longest.

For a given relative angular movement of the links of the thrust linkage, the elevational movement of the table top 9 is greatest when the table top is in its lowermost position. In progressively higher positions, the elevational movement of the table top is less for a given angular movement of the thrust links. Consequently, it is desirable that the lever arm through which the actuator acts in swinging the linkage be reasonably large when the table top is in its lowermost position of Figure 4. The lever arm need not be as great when the links are relatively unfolded as shown in Figures 1 and 2. Also, it is desirable to have the line of force of the actuator as nearly parallel as possible to the line joining the pivots of link 3 consistent with compactness of the mechanism when the linkage is in its folded position.

When it is stated, as it has been above, that the actuator 20 will react between the links of the linkage, it does not necessarily mean that the opposite ends of the actuator will be necessarily anchored respectively to the two links. While such mounting of the actuator would give the most direct action, it would be quite satisfactory for the lower end of the actuator 20 to be pivoted to the base at a location spaced from the pivot of the link to the base as is shown in the type of apparatus of Figures 6, 7 and 8. Since the actuator shown in Figures 1 to 4, inclusive, exerts a pushing force, the essential consideration is that the link 3 be capable of transmitting a force in tension.

The longer the short leg 4 of the upper link is made and the more nearly its angle with the longer leg 5 approaches a right angle, the greater will be the length of the lever arm on which the actuator 20 acts when the table is in its collapsed position if the link 3 and leg 5 are disposed substantially parallel in such condition of the table and the actuator is connected to a pivot 23 at the location of the bend. On the other hand, the shorter such leg 4 is made, the more compactly the thrust linkage can be folded so long as such link 4 is long enough to enable the longer leg 5 to be folded in substantially parallel relationship with the link 3. As fluid under pressure is pumped by the pump 21 and motor 22 into the actuator, it will be extended from the position shown in Figure 4 toward the position of Figure 3 to move the thrust links toward unfolded relationship. As shown by a comparison of Figures 3 and 4, it will be seen that the actuator 20 swings with the linkage and substantially through the same angle relative to the base that the supporting link 3 swings as the linkage unfolds.

During the movement of the thrust linkage from the position of Figure 4 to the position of Figure 3, the lever arm through which the actuator 20 acts increases somewhat in length until the short leg 4 is perpendicular to a line joining the pivots 6 and 7 and as the thrust linkage unfolds farther toward the position of Figure 2, the length of the lever arm on which the actuator acts decreases in length. If the thrust linkage were unfolded beyond the position shown in Figure 2, the lever arm on which the force of the actuator 20 would act would decrease to an undesirably small length because of the angle of bend between the short leg 4 and the long leg 5 of the upper link. It is not desirable for these legs to be disposed at any smaller angle, although the length of the lever arm would be greater when the thrust linkage is in the fully collapsed position shown in Figure 4 because the lever arm would be undesirably short when the linkage is in the extended position of Figure 2. An important advantage of the thrust linkage utilized to raise the table top 9 is that the spacing between the base and the table top is determined by the relative movement of the remote ends of the two links as they swing between folded and unfolded positions. Comparatively little separation of the link ends would occur by opening the linkage farther from the position shown in Figure 2 to a position in which the links are aligned in coplanar rela-

tionship. By use of this mechanism, therefore, a comparatively great movement of the adjustable table top 9 can be effected by compact mechanism.

The lengths of links 10 and 14 of the stabilizing linkage of the cross type shown in Figures 1 to 4, inclusive, should be sufficiently great so that when the table top 9 is in its uppermost position, the upper and lower angles between the links 10 and 14 will not be appreciably less than right angles. Otherwise the lower ends of these links and their upper ends may approach close enough so that the desired stability of the table top is difficult to maintain. It is obviously necessary, however, to make the side channels 1 of the base and the length of the table top at least as great as the length of the stabilizing linkage when the table is in the collapsed position shown in Figure 4 so as to accommodate such linkage between the table top and the base.

By providing a reservoir 24 for hydraulic liquid connected to the pump 21 and an elevating control 25 and lowering control 26 which conveniently may be of the foot pedal operated type as shown in Figure 1, the motor, pump and suitable control valves can be actuated to supply liquid under pressure to the actuator 20 for extending it to unfold the linkage 3, 4, 5 and raise the table top or to discharge liquid from the actuator to the reservoir for contraction of the actuator and lowering of the table top. If both control pedals 25 and 26 are released communication from the pump and reservoir to the line 27 connected to the actuator 20 will be cut off so that the amount of liquid in the actuator will be maintained constant. The actuator will, therefore, retain the thrust linkage in a constant position and thus maintain the table top 9 substantially stationary, irrespective of any variation in load on the table top.

In the form of adjustable elevation table described above, the actuator is of the pusher type. While the adjustable elevation table structure shown in Figures 6, 7 and 8 in most respects is similar to the construction of the table shown in Figures 1 to 5, inclusive, in this instance the actuator for effecting height adjustment of the table is of the pulling type. The table base, top and stabilizing linkage interengaged between them are the same as in the table shown in Figures 1 to 5, and the parts are numbered correspondingly. The thrust linkage connected between the base pivot 6 and the top pivot 8, however, is different.

In the table of Figures 6 to 8, inclusive, the lower link 37 of the thrust linkage is straight, as is the lower link of the thrust linkage shown in the table of Figures 1 to 5, inclusive. Also, correspondingly, the upper link of the thrust linkage shown in Figures 6 to 8, inclusive, is bent and includes an upper long leg 38 and a lower short leg 39. Moreover, the links 37 and 38, 39 in this instance, as in Figures 1 to 5, inclusive, are constructed as leaves or frames so as to have reasonable torsional rigidity. The lower end of the lower link 37 is connected to the base of the table by pivot 6 and the upper end of the upper link is connected to the top of the table by pivot 8.

The thrust linkage of the table shown in Figures 6, 7 and 8 differs from that of the thrust linkage shown in Figures 1 to 5, inclusive, in two principal respects and one minor respect. The upper end of the lower link 37 is connected to the upper link by pivot 40 which is located at the bend of the upper link instead of at the lower end of the upper link. Second, the actuator 41 which may be of the hydraulic piston-and-cylinder type is constructed to exert a pulling action rather than a pushing action like the actuator 20 of Figures 1 to 5. Third, the actuator 41 is connected by pivot 42 to the lower end of the upper link instead of being connected to the bent portion of such link and its opposite end is connected by pivot 43 to the base, although under some circumstances such lower end could alternatively be connected to the link 37.

With the actuator arrangement shown in Figures 6, 7 and 8, extension of the thrust linkage from the folded position shown in Figure 8 through the intermediate position shown in Figure 7 to the extended position shown in Figure 6 is accomplished by contracting movement of the actuator 41. When the table is in its collapsed position of Figure 8, the thrust line of the actuator 41 is virtually parallel to a line joining pivots 8 and 40 of the upper link. The lever arm on which the actuator acts is a line perpendicular to the life joining the pivots 42 and 43 and extending through the pivot 40. Because the actuator thrust line is substantially parallel to the line joining pivots 8 and 40 with the parts in the position shown in Figure 8, the action of the actuator is most effective in that condition. At the same time, the separation movement of pivots 6 and 8 is greatest for a given angular movement of the upper and lower links when the parts are in the position shown in Figure 8 so it is desirable for the thrust action of the actuator to be most effective under those circumstances.

As the thrust linkage unfolds to the position of Figure 7, the moment produced by the actuator 41 varies with the angle between the line joining pivots 8 and 40 and the line joining pivots 42 and 43. Consequently, the moment increases progressively as the thrust linkage opens from the position of Figure 8 through the position of Figure 7 and then decreases as the linkage approaches the position of Figure 6. At the same time, however, the separating movement of pivots 6 and 8 for a given relative angular movement of the links of the thrust linkage is decreasing so that it is

not necessary to have as great an operating force applied to the linkage in its open or expanded condition.

It will be evident that the angle of bend between the link legs 38 and 39 and the position of pivot 43 is important. If the angle between legs 38 and 39 were smaller, pivot 42 would be farther to the left in the unfolded position of the linkage shown in Figure 6. Also, if pivot 43 were located farther to the right, the effectiveness of the actuator would be decreased. Such shifting of pivot 42 to the left or of pivot 43 to the right would increase the angle between the line joining pivots 8 and 40 and the line joining pivots 42 and 43 which correspondingly decreases the sine of the angle between these lines and, consequently, the effectiveness of the actuator. Such alteration of the location of these pivots also would reduce the over-all length of the actuator and it would not be possible to reduce the stroke of the actuator very much and still obtain the range of table elevation adjustment which can be effected by the mechanism shown in Figures 6, 7 and 8.

The mechanism for effecting and controlling the operation of the actuator 41 shown in Figures 6, 7 and 8 can be comparable to that described in connection with Figures 1 to 5, inclusive, except that hydraulic fluid would be supplied to the piston rod end of the cylinder in the actuator 41 to unfold the thrust linkage instead of being supplied to the opposite end of the cylinder as in the case of the actuator 20 shown in Figures 1 to 5, inclusive. The action of the stabilizing linkage will be the same, of course, as in the device shown in Figures 1 to 5 so that it is unnecessary to describe such operation again.

WHAT WE CLAIM IS:—

1. A table adjustable in height comprising a base, a table top, thrust linkage, first pivot means having its axis located substantially centrally between opposite edges of said table top and connecting said thrust linkage to said table top, said thrust linkage being engaged with a portion of said base directly beneath said first pivot means, said thrust linkage including an upper link, a lower link, one of said links being bent, and second pivot means interconnecting said upper link and said lower link, actuator means pivotally connected to said bent link at only one location which location is spaced lengthwise of said bent link from said second pivot means, said actuator means being operable to effect relative swinging of said links between a folded position supporting said table top in a lowered position and an unfolded position supporting said table top in a raised position substantially parallel to such lowered position, and stabilizing means interengaged between said base and spaced portions of said table top located at opposite sides of said first pivot means and operable to maintain said first pivot means in superposed registry with the portion of said base engaged by said thrust linkage and to restrain tilting of said table top relative to said base.

2. The table as set forth in claim 1, in which the second pivot means interconnects the upper link and the lower link at a location spaced from the bend of the bent link and the actuator means is pivotally connected to the bent link adjacent to its bend and is variable in effective length to produce a pushing force on its pivot connection to the bent link for effecting relative swinging of the links toward unfolded relationship.

3. The table as set forth in claim 1, in which the second pivot means interconnects the upper link and the lower link at a location adjacent to the bend of the bent link and the pivot connection between the actuator, means and the bent link is located at the side of the second pivot means remote from the first pivot means, the actuator means being variable in effective length to exert a pulling force on the pivot connection of the actuator means to the bent link for effecting relative swinging of the links toward unfolded position.

4. Any table adjustable in height substantially as described herein with reference to and as illustrated in the accompanying diagrammatic drawings.

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3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

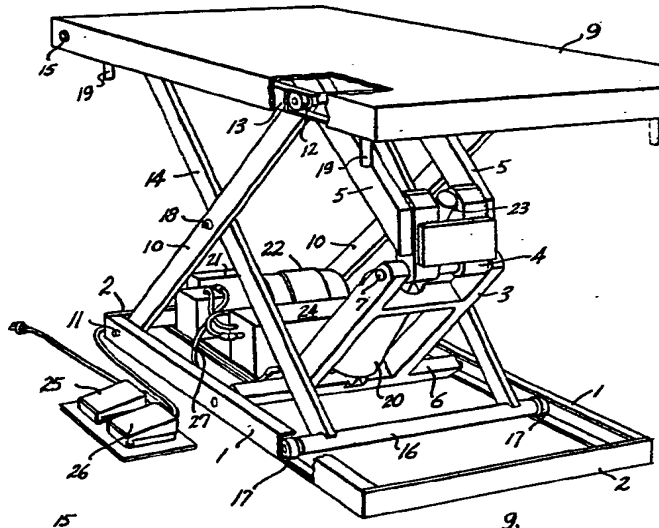

Fig. 1.

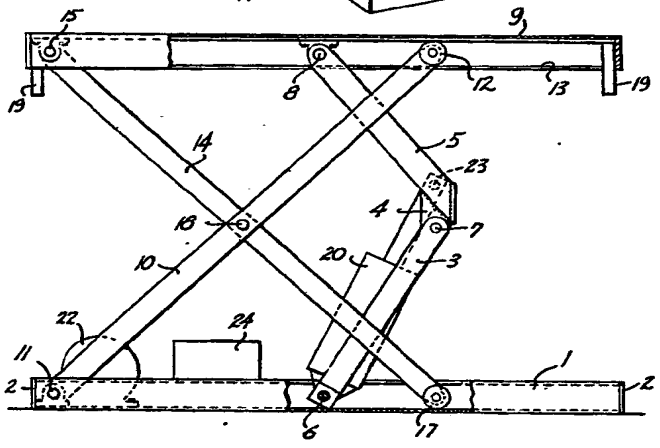

Fig. 2.

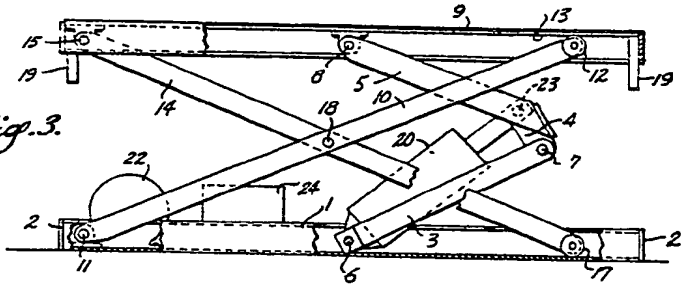

Fig. 3.

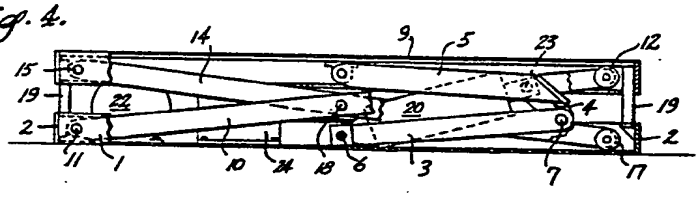

Fig. 4.

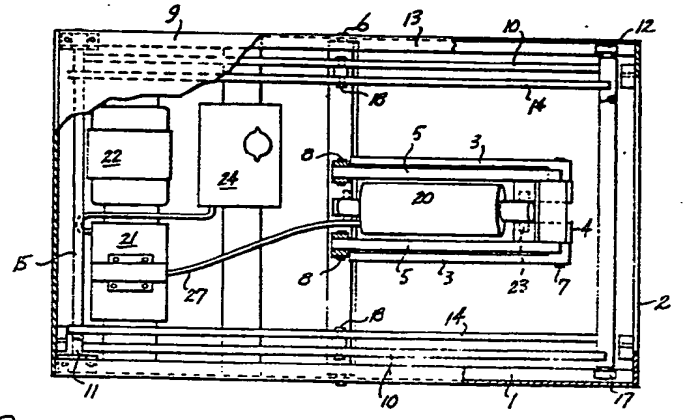

Fig. 5.

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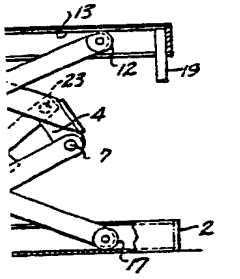
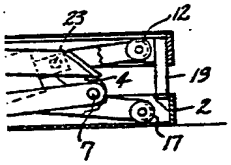
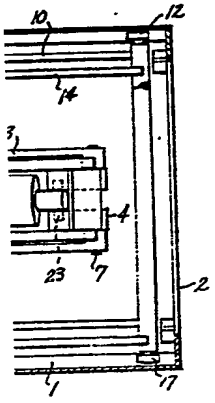
Sheets 2 & 3







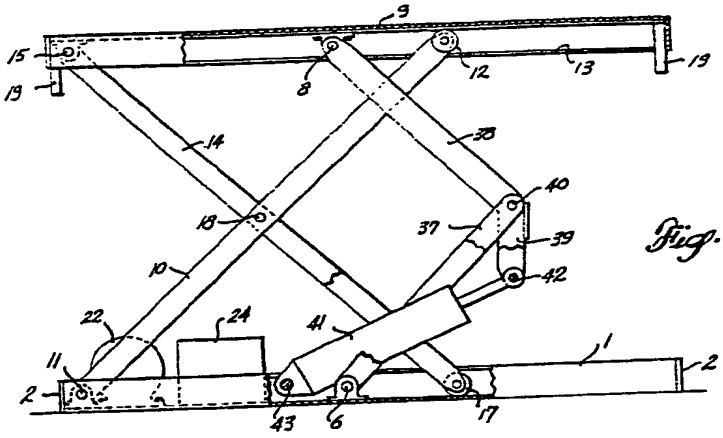


Fig. 6.

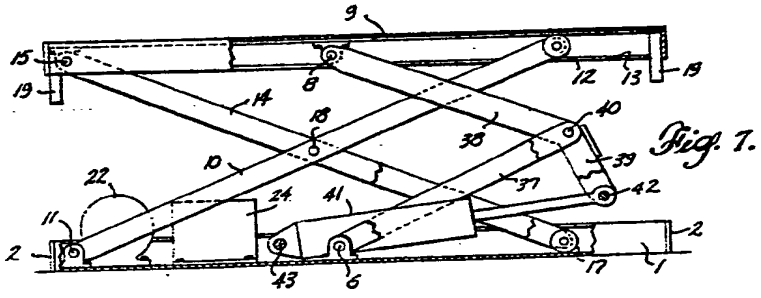


Fig. 7.

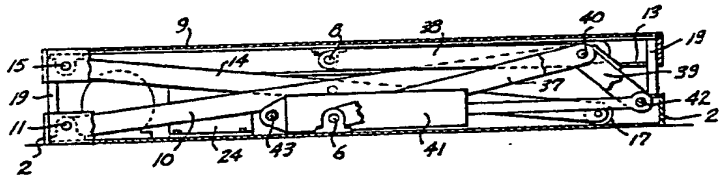


Fig. 8.

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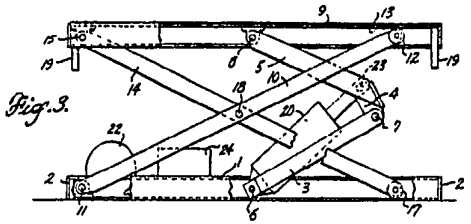

Fig. 3.

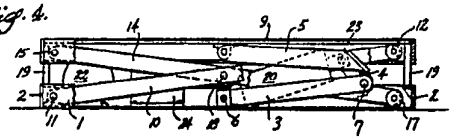

Fig. 4.

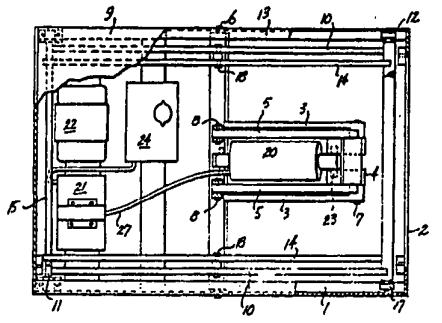

Fig. 5.

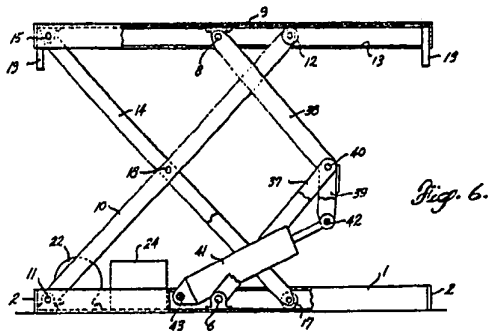

Fig. 6.

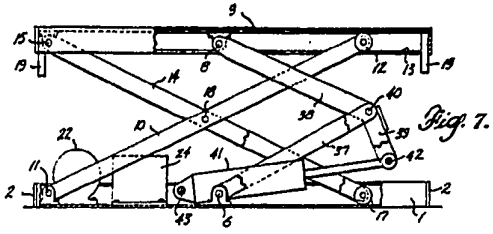

Fig. 7.

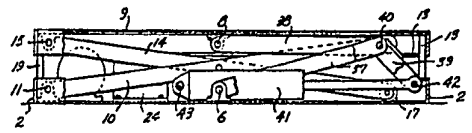

Fig. 8.